

Claim Pages

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7. (Currently Amended) A heat spreader adapted to be insert-molded with resin on a surface of a circuit board on which a semiconductor chip is mounted so that said heat spreader covers said surface of the circuit board including an upper surface of said semiconductor chip over substantially a same area as that covered with molded resin when insert-molded with resin.

said heat spreader comprising:

a first surface positioned at a side of said circuit board and adhered with resin when insert-molded with resin; and

a second surface positioned opposite to said first surface and at least a part thereof defining an exposed surface when insert-molded with resin;

said heat spreader further comprising:

a first part, at the first surface thereof, defining a first gap with respect to said surface of the circuit board when insert-molded with resin and at the second surface thereof, defining said exposed surface when insert-molded with resin; and

a second part, at the first surface thereof, defining a second gap with respect to said surface of the circuit board when insert-molded with resin, said second gap being smaller than said first gap and, at the second surface thereof, being adhered to and embedded in resin when insert-molded with resin, wherein said third parts are provided on said second part, A heat spreader as set forth in claim 6 further comprising, in a plan view thereof in parallel to said surface of the circuit board when insert-molded with resin:

a central region recessed toward said surface of the circuit board to define a recessed portion constituting at least a part of said second part; and

said recessed portion comprising a bottom portion provided with at least one resin hole through which resin flows when insert-molding and a peripheral portion provided with at least one ventilation hole through which air is ventilated when insert-molding; and

said recessed portion, at the second surface thereof, being adhered to and embedded in resin when insert-molded with resin.

8. (Currently Amended) A heat spreader adapted to be insert-molded with resin on a surface of a circuit board on which a semiconductor chip is mounted so that said heat spreader covers said surface of the circuit board including an upper surface of said semiconductor ship over substantially a same area as that covered with molded resin when insert-molded with resin, said heat spreader having:

a first, main portion which defines a first gap with respect to said surface of the circuit board when insert-molded with resin; and

a second portion which defines a second gap with respect to said surface of the circuit board when insert-molded with resin, said second gap being smaller than said first gap, so that at least said second portion is embedded in said mold resin when insert-molded with resin, wherein said third portions are provided on said second portions. ~~A heat spreader as set forth in claim 3~~ further comprising, in a plan view thereof in parallel to said surface of the circuit board when insert-molded with resin:

an outer peripheral region stepped toward said surface of the circuit board to constitute at least a part of said second part along an outer periphery thereof; and

said outer peripheral region, at the second surface thereof, being adhered to and embedded in resin when insert-molded with resin.

9. (Currently Amended) A heat spreader adapted to be insert-molded with resin on a surface of a circuit board on which a semiconductor chip is mounted so that said heat spreader covers said surface of the circuit board including an upper surface of said semiconductor ship over substantially a same area as that covered with molded resin when insert-molded with resin, said heat spreader having:

a first, main portion which defines a first gap with respect to said surface of the circuit board when insert-molded with resin; and

a second portion which defines a second gap with respect to said surface of the circuit board when insert-molded with resin, said second gap being smaller than said first gap, so that at least said second portion is embedded in said mold resin when insert-molded with resin, wherein said third portions are provided on said second portions, A heat spreader as set forth in claim 3 further comprising, in a plan view thereof in parallel to said surface of the circuit board when insert-molded with resin:

a central region recessed toward said surface of the circuit board to define a recessed portion constituting at least a part of said second part, and said recessed portion comprising a bottom portion provided with at least one resin hole through which resin flows when insert-molding and a peripheral portion provided with at least one ventilation hole through which air is ventilated when insert-molding; and said recessed portion, at the second surface thereof, being adhere to and embedded in resin when insert-molded with resin;

an outer peripheral region stepped toward said surface of the circuit board to constitute at least a part of said second part along an outer periphery thereof; and said outer peripheral region at the second surface thereof, being adhered to and embedded in resin when insert-molded with resin; and

an intermediate region between said central region and said peripheral region, at the second surface thereof, defining an exposed surface when insert-molded with resin.

10. (Original) A heat spreader as set forth in claim 9 further comprising, when insert-molding with resin:

means for defining a first cavity between said first surface of this heat spreader and said surface of the circuit board and means for defining a second cavity between said second surface of this heat spreader and an insert mold frame which is in contact with said first part, at the second surface thereof, and with a peripheral edge of said heat spreader; and

both said first and second cavities being filled with resin when insert molded, and a volume of said first cavity being larger than a total volume of said second cavity.

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14. (Original) A semiconductor device comprising:
a circuit board having a surface;
a semiconductor chip mounted on said surface of the circuit board; and
a heat spreader insert-molded with resin on a surface of a circuit board so
that said heat spreader covers said surface of the circuit board including an upper surface
of said semiconductor chip over substantially a same area as that covered with molded
resin;
said heat spreader comprising:
a first surface positioned at a side of said circuit board and adhered
with resin; and
a second surface positioned opposite to said first surface and at
least a part thereof defining an exposed surface;
said heat spreader further comprising:
a first part, at the first surface thereof, defining a first gap with
respect to said surface of the circuit board and, at the second surface thereof, defining
said exposed surface; and
a second part, at the first surface thereof, defining a second gap
with respect to said surface of the circuit board, said second gap being smaller than said
first gap and, at the second surface thereof, being adhered to and embedded in resin; and
said resin insert-molded with said heat spreader integrally on said
surface of the circuit board so as to cover an area of said surface including an upper
surface of said semiconductor chip, so that said second part of the heat spreader, at the
first surface thereof, is adhered to and embedded in said resin.

15. (Original) A semiconductor device as set forth in claim 14, wherein
said heat spreader further comprises a plurality of third parts, at the first surface thereof,
which are in contact with said surface of the circuit board.

16. (Original) A semiconductor device as set forth in claim 14, wherein
said third parts are provided on said second part.

17. (Original) A semiconductor device as set forth in claim 14, wherein said heat spreader further comprises, in a plan view thereof in parallel to said surface of the circuit board:

a central region recessed toward said surface of the circuit board to define a recessed portion constituting a least a part of said second part; and

said recessed portion comprising a bottom portion provided with at least one resin hole through which resin flows when insert-molding and a peripheral portion provided with at least one ventilation hole through which air is ventilated when insert-molding; and

said recessed portion, at the second surface thereof, being adhered to and embedded in resin.

18. (Original) A semiconductor device as set forth in claim 14, wherein said heat spreader further comprises, in a plan view thereof in parallel to said surface of the circuit board:

an outer peripheral region stepped toward said surface of the circuit board to constitutes at least a part of said second part along an outer periphery of the heat spreader; and

said outer peripheral region, at the second surface thereof, being adhered to and embedded in resin.

19. (Original) A semiconductor device as set forth in claim 14, wherein said heat spreader further comprises, in a plan view thereof in parallel to said surface of the circuit board:

a central region recessed toward said surface of the circuit board to define a recessed portion constituting at least a part of said second part, and said recessed portion comprising a bottom portion provided with at least one resin hole through which resin flows when insert-molding and a peripheral portion provided with at least one ventilation hole through which air is ventilated when insert-molding; and said recessed portion, at the second surface thereof, being adhered to and embedded in resin;

an outer peripheral region stepped toward said surface of the circuit board to constitute at least a part of said second part along an outer periphery of the heat spreader; and said outer peripheral region, at the second surface thereof, being adhered to and embedded in resin; and

an intermediate region between said central region and said peripheral region, at the second surface thereof, defining an exposed surface.

20. (Original) A semiconductor device as set forth in claim 14, wherein said heat spreader further comprises, when insert-molding with resin:

means for defining a first cavity between said first surface of this heat spreader and said surface of the circuit and means for defining a second cavity between said second surface of this heat spreader and an insert mold frame which is in contact with said first part, at the second surface thereof, and with a peripheral edge of said heat spreader; and

both said first and second spaces being filled with resin, and a volume of said first cavity is larger than a total volume of said second cavity.

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